



SLR Contribution to the new Regional Navigation Satellite System of Korea

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Overview of KPS (Korean Positioning System)

Objectives

Providing high-precision PNT information required in the era of the 4th industrial revolution

Goals

Development and construction of KPS system that stably provides PNT services to meet various satellite navigation needs



Program

KPS R&D Program
(including Space, Ground and User Segment)

Period

2022~2035 (14 years)

Governing

 과학기술정보통신부
Ministry of Science and ICT

R&D

 KARI 한국항공우주연구원
KOREA AEROSPACE RESEARCH INSTITUTE

Source: <https://www.unoosa.org/documents/pdf/icg/2022/ICG16/08.pdf>

KPS Services

Open Service



- To provide PNT services free of charge
- Signals : L1/L2/L5/L6/S

Meter Level Service



- To provide correction data for meter-level accuracy
- Signals : L1

Centimeter Level Service



- To provide correction data for centimeter-level accuracy
- Signals : L6

SBAS Service



- To broadcast KASS(SBAS) data
- Signals : L1/L5

Public Safety Service



- To provide PNT services for government-authorized users
- Signals : L6/S

Search and Rescue Service



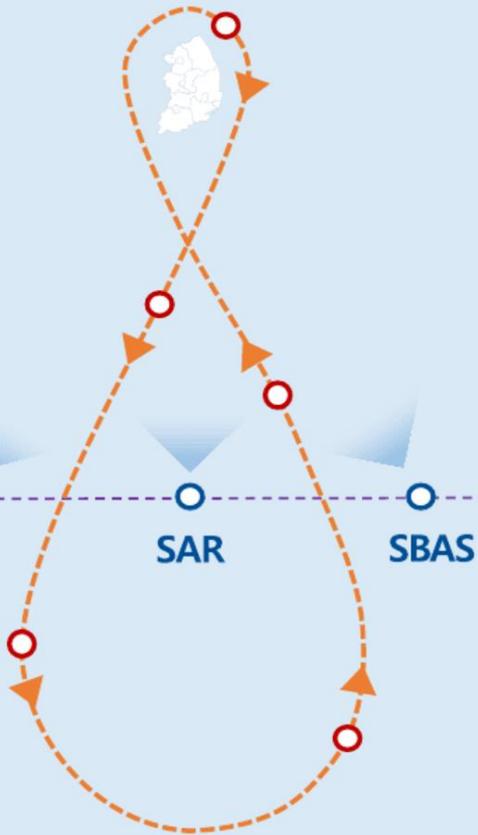
- To relay rescue signal to COSPAS-SARSAT facilities
- Signals : L

Source: <https://www.unoosa.org/documents/pdf/icg/2022/ICG16/08.pdf>

KPS System Configuration

KPS Satellite Constellation

- 3 GEO
- 5 IGSO



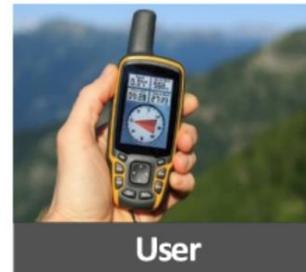
KPS Segments



- 3 GEO Satellites
- 5 IGSO Satellites
- Payloads : Navigation, Time-sync., SBAS, and SAR



- Operation Centers
- Satellite Control Centers
- Antenna Stations
- Monitoring Stations
- Mission Control Stations for MLS/CMLS



- Research and Development Receiver
- Reference Station Receiver
- Test and Evaluation Receiver
- User Receivers

Source: <https://www.unoosa.org/documents/pdf/icg/2022/ICG16/08.pdf>

KPS Development Plan

System Design ('22~'24)

- SDR/PDR/CDR of KPS system
- International cooperation for orbits, frequencies, sites acquisition
- Navigation signal and constellation design

System Development ('25~'28)

- Development of satellite bus and payloads
- Development of satellite control center and antenna station
- Launch of the 1st IGSO satellite in 2027

Deployment and Validation ('29~'35)

- Development and launch of the 4 IGSO and 3 GEO satellites
- Development of all of the ground segment
- Test during IOC and FOC

Source: <https://www.unoosa.org/documents/pdf/icg/2022/ICG16/08.pdf>

The Role of KASI in KPS/SLR

SLR in GNSS

Precise Orbit Determination(POD) of GNSS satellites
Calibration & validation of GNSS orbit quality
Improvement of the dynamic and measurement model
Maintain the GNSS reference coordinate system

KASI in KPS/SLR

Observation of KPS satellites for radial ranging validation
Development of LRA for KPS satellites
Design & construction of a GNSS-dedicated SLR station(TBD)
Orbit determination of KPS satellites with GNSS data(Phase II)



LRA for KPS(I)

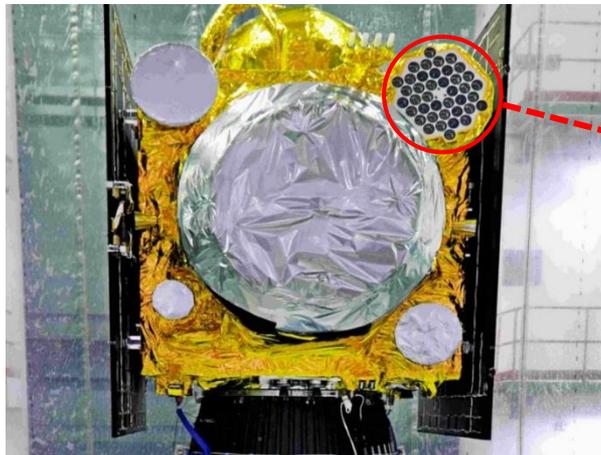
- LRA standards for GNSS Satellites

- Laser cross section $\sim 100\text{M m}^2$ for 20,000 km altitude (5 times of GPS-35/36)

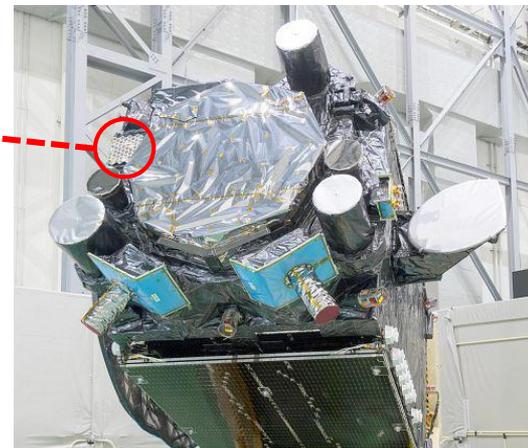
GNSS	GPS*	Glonass	Galileo	BeiDou	QZSS	NavIC
# LRA Satellites	0/31	23/23	26/26	9/9	4/4	6/6
Manufacturer	IPIE (Russia)	IPIE (Russia)	NCRIEO (China) IPIE (Russia)	SHAO† (China)	Honeywell (USA)	LEOS (India)

* Past: GPS Block-IIA (35,36), Future: Block-IIIF (all)

† SHAO : Shanghai Astronomical Observatory

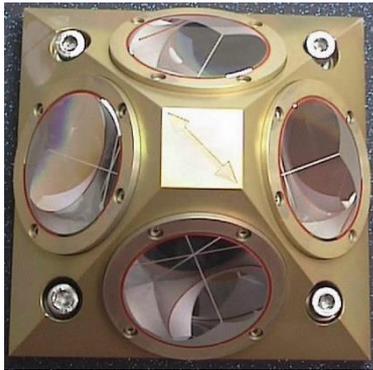


NavIC Satellite



QZSS Satellite

LRA for KPS(II)



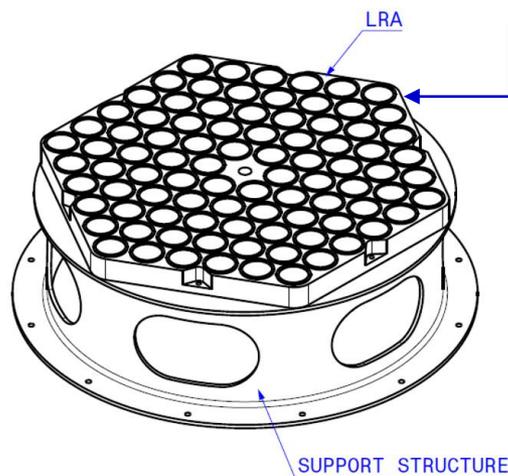
LRA for KOMPSAT-5



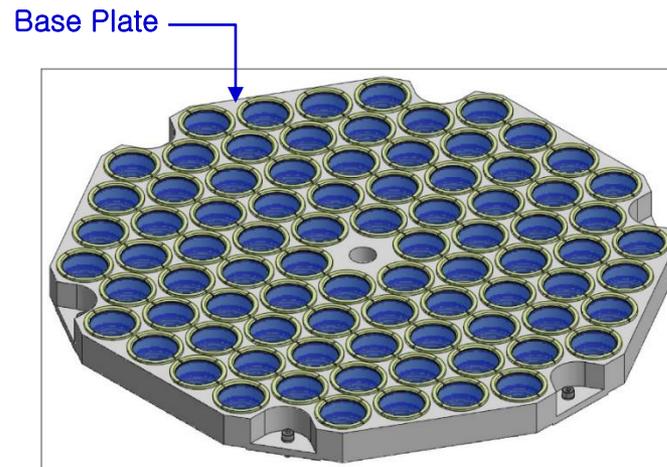
LRA for GK-2B (84 CCRs)



LRA on GK-2B



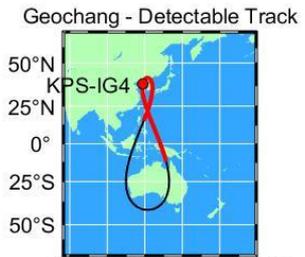
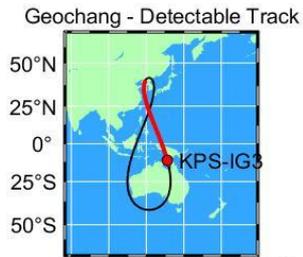
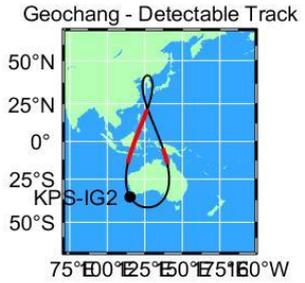
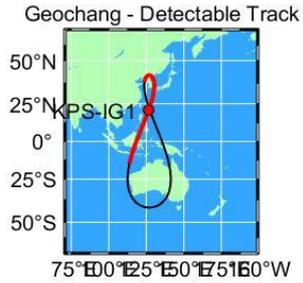
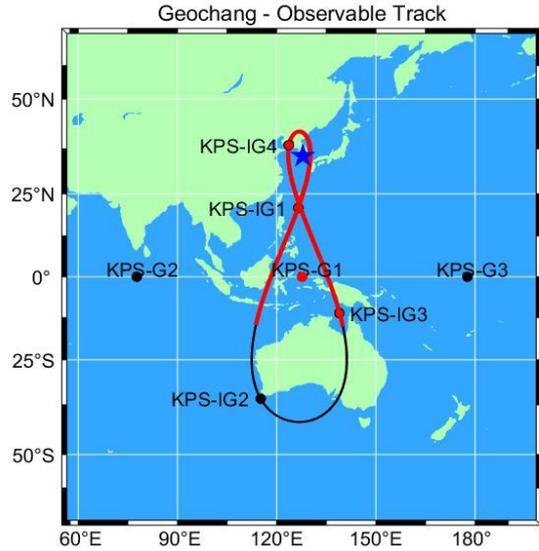
GK-2B (84 CCRs)



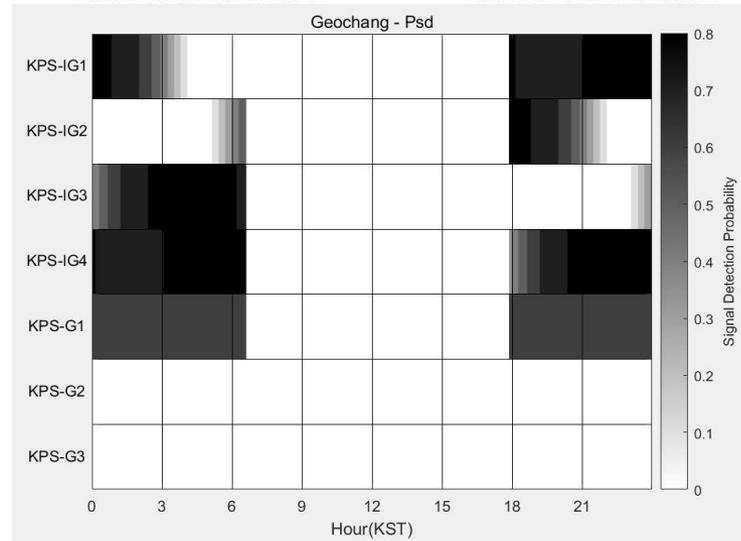
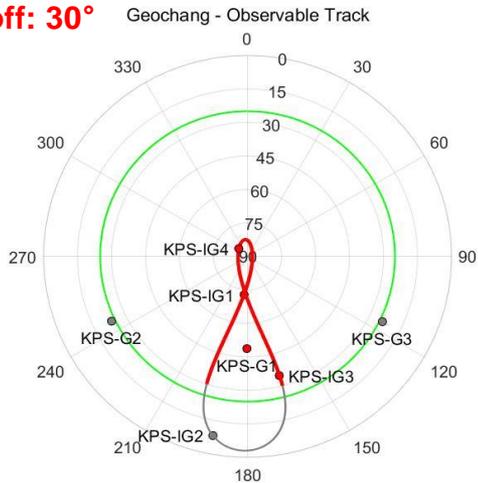
Preliminary Design for KPS Satellite (84 CCRs)

Diameter : 506mm (TBD)
Height : 48mm (TBD)
Weight : ~8Kg (TBD)

KPS Tracking Capability at Geochang Station



Elevation Cutoff: 30°



Summary

1. Korean Positioning System will provide 6 PNT services around the Korean peninsula from 2035/36.
2. First KPS satellite will be launched at 2027 and all the KPS satellites (5 IGSO + 3 GEO) will be equipped with LRA for SLR Observation.
3. Observation of KPS satellites, development of LRA and other SLR-related works are the roles of KASI in KPS program.
4. LRA for KPS satellite has been designing based on the GK-2B heritage.
5. KPS tracking capability at Geochang station is less than half of the day (30° elevation cutoff angle) and the signal detection probability has relatively wide range because of geometric and environmental configuration.
6. KPS program is considering a new GNSS-dedicated SLR station.
7. Support from ILRS, especially WPLTN, is essential for the KPS launch campaign and the testing and/or operation phase of KPS

THANK YOU FOR YOUR ATTENTION!!